IN THE CLAIMS:

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

1(Currently Amended).   A method of binary coded data communication, the method comprising the steps of:

providing a transmitter having a turbo trellis coded modulator (TTCM) encoder and constellation shaping elements; and

generating a plurality of signal points in response to a partitioned binary coded symbol sequence that is processed via the TTCM encoder and constellation shaping elements, wherein the partitioned symbol sequence comprises a first part having K-bits, a second part having N*k-bits, and a third part having the remaining bits and wherein K and N are integers.

2(Currently Amended).   The method according to claim 1 wherein the step of generating a plurality of signal points in response to a partitioned binary coded symbol sequence that is processed via the TTCM encoder and constellation shaping elements comprises the step of generating a signal constellation having square shaping regions capable of use in association with trellis shaping that is compatible with rate k_c/n_c TTCM, such that a binary k_c-tuple portion of a desired symbol sequence can be processed via the TTCM encoder for a rate k_c/n_c TTCM code to generate a n_c-tuple, wherein k_c and n_c are integers.

3(Currently Amended).   The method according to claim 1 wherein the step of generating a plurality of signal points in response to a partitioned binary coded symbol sequence that is processed via the TTCM encoder and constellation shaping elements comprises the step of generating a signal constellation having spherical shaping regions capable of use in association with trellis shaping that is compatible with rate k_c/n_c TTCM, such that a binary k_c-tuple portion of a desired symbol sequence can be processed via the TTCM encoder for a rate k_c/n_c TTCM code to generate a n_c-tuple, wherein k_c and n_c are integers.

4(Currently Amended).   The method according to claim 1 wherein the step of providing a transmitter having ~~a turbo trellis coded modulator (TTCM)~~ the TTCM encoder and constellation shaping elements comprises the step of providing trellis precoding elements and <u>Tomlinson-Harashima (TH)</u>-precoding elements capable of use with non-square constellations.

5(Currently Amended).   The method according to claim 1 wherein the step of generating a plurality of signal points in response to a partitioned binary coded symbol sequence that is processes via the TTCM encoder and constellation shaping elements comprises partitioning a signal constellation into cosets and shells in compliance with <u>a</u> shell mapping and <u>the</u> TTCM <u>encoder</u>.

6(Currently Amended).   The method of binary coded data communication according to claim 1 wherein the step of generating a plurality of signal points comprises the steps of:

dividing a desired symbol sequence into a binary k_c -tuple, an uncoded binary n_u -tuple, and a syndrome r_s -tuple;

processing the <u>binary</u> k_c -tuple ~~part~~ of the desired symbol sequence via the ~~turbo trellis coded modulator (TTCM)~~ <u>TTCM</u> encoder for a rate k_c/n_c TTCM code to generate a n_c -tuple;

processing the <u>syndrome</u> r_s -tuple ~~part~~ of the desired symbol sequence via a coset representative generator for a rate k_s/n_s convolutional shaping code, where $k_s = n_s - r_s$ to generate a n_s -tuple;

processing the uncoded binary n_u -tuple ~~part~~ of the desired symbol sequence, the output of the ~~rate k_c/n_c~~ TTCM encoder, and the output of the coset representative generator for a rate k_s/n_s convolutional shaping code via a decoder to generate a desired bit sequence;

processing the desired bit sequence and the output of the coset representative generator for [[a]] <u>the</u> rate k_s/n_s convolutional shaping code via a combinational element to generate a selected bit sequence; and

mapping the selected bit sequence, the uncoded binary n_u -tuple ~~part~~ of the desired symbol sequence, and the output of the ~~rate k_c/n_c~~ TTCM encoder to generate the plurality of signal points<u>, wherein k_c, k_s, n_c, n_u, r_s, and n_s are integers</u>.

7(Currently Amended).   The method according to claim 6 further comprising the steps of:

providing a receiver having a <u>receiver</u> turbo decoder and <u>receiver</u> constellation shaping elements; and

processing the plurality of signal points via the receiver turbo decoder and the receiver constellation shaping elements to recover the partitioned <u>binary coded</u> symbol sequence.

8(Currently Amended).   The method according to claim 7 wherein the step of processing the plurality of signal points via the receiver turbo decoder and the receiver constellation shaping elements to recover the partitioned <u>binary coded</u> symbol sequence comprises processing the plurality of signal points via the <u>receiver</u> turbo decoder using a non equi-probable symbol distribution.

9(Currently Amended).   The method according to claim 7 wherein the step of processing the plurality of signal points via the receiver turbo decoder and the receiver constellation shaping elements comprises the steps of:

receiving the plurality of signal points via a transmission medium and processing the received plurality of signal points via the <u>receiver</u> turbo decoder to generate estimated signal points; and

processing the estimated signal points via an inverse mapper to generate an estimated binary k_c-tuple part of the desired bit sequence according to the rate k_c/n_c TTCM code, an estimated uncoded binary n_u-tuple part of the desired bit sequence, and an estimated binary r_s-tuple part of the desired bit sequence according to the rate k_s/n_s convolutional shaping code.

10(Currently Amended).   The method according to claim 7 wherein the step of processing the plurality of signal points via the receiver turbo decoder and the receiver constellation shaping elements further comprises the step of processing the <u>an</u> estimated binary k_c-tuple part of the desired bit sequence according to the rate k_c/n_c TTCM code to recover k bits based on n bits and to generate an <u>the</u> estimated binary k_c-tuple part of the desired symbol sequence.

11(Currently Amended).   The method according to claim 10 wherein the step of processing the plurality of signal points via the receiver turbo decoder and the receiver constellation shaping elements further comprises the step of processing ~~the~~ an estimated syndrome ~~binary~~ r_s-tuple ~~part~~ of the desired bit sequence according to the rate k_s/n_s convolutional shaping code to generate ~~an~~ the estimated syndrome r_s-tuple part of the desired symbol sequence.

12(Original).   The method according to claim 1 further comprising the step of processing the plurality of signal points via a trellis precoder to generate a coded symbol sequence.

13(Currently Amended).   The method according to claim 12 further comprising the steps of:

        providing a receiver having a receiver turbo decoder and receiver constellation shaping elements; and

        processing the plurality of signal points via the receiver turbo decoder and the receiver constellation shaping elements to recover the partitioned symbol sequence.

14(Currently Amended).   The method according to claim 13 wherein the step of processing the plurality of signal points via the receiver turbo decoder and the receiver constellation shaping elements to recover the partitioned binary symbol sequence comprises processing the plurality of signal points via the receiver turbo decoder using a non equi-probable symbol distribution.

15(Currently Amended).   The method according to claim 12 wherein the step of processing the plurality of signal points via the receiver turbo decoder and the receiver constellation shaping elements comprises the steps of:

        folding the coded symbol sequence to generate a folded constellation;

        processing the folded constellation via the receiver turbo decoder to generate estimated signal points; and

        processing the estimated signal points via an inverse mapper to generate an estimated binary k_c-tuple ~~part~~ of the desired bit sequence according to the rate k_c/n_c TTCM code, an estimated uncoded binary n_u-tuple ~~part~~ of the desired symbol sequence, and an estimated binary r_s-tuple ~~part~~

of the desired bit sequence according to the rate k_s/n_s convolutional shaping code, wherein k_c, n_c, n_u, r_s, k_s, and n_s are integers.

16(Currently Amended).   The method according to claim 15 wherein the step of processing the plurality of signal points via the receiver turbo decoder and the receiver constellation shaping elements further comprises the step of processing ~~the~~ an estimated binary k_c-tuple ~~part~~ of the desired bit sequence according to the rate k_c/n_c TTCM code to recover k bits based on n bits and to generate ~~an~~ the estimated binary k_c-tuple ~~part~~ of the desired symbol sequence.

17(Currently Amended).   The method according to claim 16 wherein the step of processing the plurality of signal points via the receiver turbo decoder and the receiver constellation shaping elements further comprises the step of processing ~~the~~ an estimated syndrome ~~binary~~ r_s-tuple ~~part~~ of the desired bit sequence according to the rate k_s/n_s convolutional shaping code to generate an estimated syndrome r_s-tuple part of the desired symbol sequence.

18(Currently Amended).   The method of binary coded data communication according to claim 1 wherein the step of generating a plurality of signal points comprises the steps of:

~~dividing a desired symbol sequence into a first part having K bits, a second part having N*k bits, and a third part having the remaining bits~~;

processing the first part of the desired symbol sequence via a shell mapper to generate N shells;

processing the second part of the desired symbol sequence via the TTCM encoder to generate N cosets; and

mapping the third part of the desired symbol sequence, the N shells, and the N cosets to generate ~~a number N of~~ N transmit symbols, wherein N, K, and k are integers.

19(Currently Amended).   The method of binary coded data communication according to claim 18 further comprising the steps of:

providing a receiver having a receiver turbo decoder and receiver constellation shaping elements; and

processing the N ~~received~~ symbols via the receiver turbo decoder and the receiver constellation shaping elements to recover the desired symbol sequence.

20(Currently Amended).   The method according to claim 19 wherein the step of processing the N ~~received~~ symbols via the receiver turbo decoder and the receiver constellation shaping elements to recover the desired symbol sequence comprises processing the N ~~received~~ symbols via the turbo decoder using a non equi-probable symbol distribution.

21(Currently Amended).   The method of binary coded data communication according to claim 19 wherein the step of processing the N ~~received~~ symbols comprises the steps of:

decoding the N ~~received~~ symbols via the turbo <u>receiver</u> decoder to generate N hard symbols;

de-mapping the N hard symbols into the first part of the desired symbol sequence via a shell de-mapper;

mapping the N hard symbols into the remaining part of the desired symbol sequence via a symbols to bits mapper; and

combining the first part of the desired symbol sequence recovered by the shell de-mapper with ~~the~~ remaining part of the desired symbol sequence recovered by the symbols to bits mapper to recover the desired symbol sequence at the receiver.

22 (Currently Amended).   The method of binary coded data communication according to claim 18 further comprising the step of processing the N ~~transmit~~ symbols via a Laroia precoder to generate a precoded symbol sequence.

23(Currently Amended).   The method of binary coded data communication according to claim 22 further comprising the steps of:

providing a receiver having a turbo <u>receiver</u> decoder and <u>receiver</u> constellation shaping elements; and

processing the ~~coded~~ <u>precoded</u> symbol sequence via the receiver turbo decoder and the receiver constellation shaping elements to recover the desired symbol sequence.

24(Currently Amended).   The method according to claim 23 wherein the step of processing the ~~coded~~ precoded symbol sequence via the receiver turbo decoder and the receiver constellation shaping elements to recover the desired symbol sequence comprises processing the ~~coded~~ precoded symbol sequence via the turbo decoder using a non equi-probable symbol distribution.

25(Currently Amended).   The method of binary coded data communication according to claim 23 wherein the step of processing the coded symbol sequence comprises the steps of:

decoding the ~~coded~~ precoded symbol sequence via the turbo decoder to generate N hard symbols;

processing N hard symbols to reconstruct symbols ~~appearing at~~ by the Laroia precoder input;

de-mapping the reconstructed symbols into the first part of the desired symbol sequence via a shell de-mapper;

mapping the reconstructed symbols into ~~the~~ remaining part of the desired symbol sequence via a symbols to bits mapper; and

combining the first part of the desired symbol sequence recovered by the shell de-mapper with the remaining part of the desired symbol sequence recovered by the symbols to bits mapper to recover the desired symbol sequence at the receiver.

26(Currently Amended).   A binary coded data communication system comprising:

a transmitter having a turbo trellis coded modulator (TTCM) encoder and constellation shaping elements; and

a receiver having a turbo receiver decoder and a receiver constellation shaping elements, wherein

the transmitter is operational to generate a plurality of signal points in response to a partitioned symbol sequence that is processed via the TTCM encoder and constellation shaping elements, ~~and further wherein~~

the receiver is operational to receive the plurality of signal points over a transmission medium and recover the partitioned symbol sequence in response to the plurality of signal points that are received and processed via the receiver turbo decoder and the receiver constellation shaping elements, and

the partitioned symbol sequence comprises a first part having K-bits, a second part having N*k-bits, and a third part having remaining bits.

27(Original).   The binary coded data communication system according to claim 26 wherein the turbo decoder employs a non equi-probable symbol distribution.

28(Original).   The binary coded data communication system according to claim 26 wherein the constellation shaping elements comprise trellis shaping elements.

29(Currently Amended).   The binary coded data communication system according to claim 28 wherein the turbo trellis coded modulator (TTCM) encoder is configured to generate a rate k_c/n_c TTCM code in response to a k_c -tuple part of a desired symbol sequence, and further wherein the ~~transmitter~~ constellation shaping elements of the transmitter comprise:

a coset representative generator configured to generate a rate k_s/n_s convolutional shaping code, where $k_s = n_s - r_s$, in response to a r_s -tuple part of the desired symbol sequence;

a shaping code decoder configured to generate a desired bit sequence in response to an uncoded binary n_u -tuple part of the desired symbol sequence, the rate k_c/n_c TTCM code, and the rate k_s/n_s convolutional shaping code;

a combinational element configured to generate a transmit symbol sequence in response to the desired bit sequence and the rate k_s/n_s convolutional shaping code; and

a mapper configured to generate a plurality of signal points in response to the transmit symbol sequence, the uncoded binary n_u -tuple part of the desired symbol sequence, and the generated rate k_c/n_c TTCM code, wherein k_c, n_c, n_u, r_s, k_s, and n_s are integers.

30(Original).   The binary coded data communication system according to claim 29 wherein the turbo decoder is configured to receive the plurality of signal points via a transmission medium and generate estimated signal points therefrom, and further wherein the receiver constellation shaping elements comprise an inverse mapper configured to receive and process the estimated signal points to generate an estimated binary k_c -tuple part of the desired bit sequence according to the rate k_c/n_c

TTCM code, an estimated binary n_u-tuple part of the desired symbol sequence, and an estimated binary r_s-tuple part of the desired bit sequence according to the rate k_s/n_s convolutional shaping code.

31(Original).   The binary coded data communication system according to claim 30 wherein the receiver constellation shaping elements further comprise a bit recovery element configured to process the estimated binary k_c-tuple part of the desired bit sequence according to the rate k_c/n_c TTCM code such that k bits can be recovered based on n bits to generate an estimated binary k_c-tuple part of the desired symbol sequence.

32(Original).   The binary coded data communication system according to claim 31 wherein the receiver constellation shaping elements further comprise a transformation element configured to process the estimated binary r_s-tuple part of the desired bit sequence according to the rate k_s/n_s convolutional shaping code and therefrom generate an estimated syndrome r_s-tuple part of the desired symbol sequence.

33(Original).   The binary coded data communication system according to claim 29 wherein the transmitter further comprises a trellis precoder operational to generate a coded symbol sequence in response to the plurality of signal points.

34(Original).   The binary coded data communication system according to claim 33 wherein the receiver further comprises a folding element operational to generate a folded constellation in response to the coded symbol sequence.

35(Original).   The binary coded data communication system according to claim 34 wherein the turbo decoder is configured to generate estimated signal points in response to the folded constellation, and the receiver constellation shaping elements further comprise an inverse mapper configured to generate an estimated binary k_c-tuple part of the desired bit sequence according to the rate k_c/n_c TTCM code, an estimated uncoded binary n_u-tuple part of the desired symbol

sequence, and an estimated binary r_s-tuple part of the desired bit sequence according to the rate k_s/n_s convolutional shaping code in response to the estimated signal points.

36(Original).   The binary coded data communication system according to claim 35 wherein the receiver constellation shaping elements further comprise a bit recovery element configured to process the estimated binary k_c-tuple part of the desired bit sequence according to the rate k_c/n_c TTCM code such that k bits can be recovered based on n bits to generate an estimated binary k_c-tuple part of the desired symbol sequence.

37(Original).   The binary coded data communication system according to claim 36 wherein the receiver constellation shaping elements further comprise a transformation element configured to process the estimated binary r_s-tuple part of the desired bit sequence according to the rate k_s/n_s convolutional shaping code and therefrom generate an estimated syndrome r_s-tuple part of the desired symbol sequence.

38(Original).   The binary coded data communication system according to claim 28 wherein the trellis precoder comprises a Tomlinson-Harashima precoder.

39(Original).   The binary coded data communication system according to claim 26 wherein the constellation shaping elements comprise shell mapping elements.

40(Currently Amended).   The binary coded data communication system according to claim 39 wherein the ~~partitioned symbol sequence comprises a first part having K bits, a second part having N*k bits, and a third part having the remaining bits, and further wherein the transmitter~~ TTCM encoder <u>of the transmitter</u> is configured to process the second part of the partitioned symbol sequence to generate N cosets.

41(Currently Amended).   The binary coded data communication system according to claim 40 wherein the ~~transmitter~~ constellation shaping elements <u>of the transmitter</u> comprise:

a shell mapper configured to process the first part of the partitioned symbol sequence to generate N shells; and

a mapper configured to process the third part of the partitioned symbol sequence, the N shells, and the N cosets to generate ~~a number N of~~ N̲ transmit symbols.

42(Currently Amended).   The binary coded data communication system according to claim 41 wherein the receiver turbo decoder is configured to process the N ~~receive~~ symbols to generate N hard symbols and wherein the receiver constellation shaping elements comprise:

a symbols-to-bits mapper configured to map the N hard symbols into the third part of the partitioned symbol sequence;

a shell de-mapper configured to de-map the N hard symbols into the first part of the partitioned symbol sequence; and

a combinational element configured to combine the first part of the partitioned symbol sequence recovered by the shell de-mapper with the third part of the partitioned symbol sequence recovered by the symbols-to-bits mapper to recover the partitioned symbol sequence at the receiver.

43(Currently Amended).   The binary coded data communication system according to claim 41 wherein the transmitter further comprises a Laroia precoder operational to generate a precoded symbol sequence in response to the N ~~transmit~~ signals.

44(Original).   The binary coded data communication system according to claim 43 wherein the receiver turbo decoder is configured to process the coded symbol sequence to generate N hard symbols and wherein the receiver constellation shaping elements comprise:

a symbol processor configured to process the N hard symbols to reconstruct symbols appearing at the Laroia precoder input;

a shell de-mapper configured to de-map the reconstructed symbols into the first part of the desired symbol sequence;

a symbols-to-bits mapper configured to map the reconstructed symbols into the remaining part of the desired symbol sequence; and

a combinational element configured to combine the first part of the desired symbol sequence recovered by the shell de-mapper with the remaining part of the desired symbol sequence recovered by the symbols-to-bits mapper to recover the partitioned symbol sequence at the receiver.

45(Currently Amended).   A method of binary coded data communication, the method comprising the steps of:

providing a receiver having a turbo trellis coded modulator (TTCM) decoder and constellation shaping elements; and

processing a plurality of signal points via the TTCM decoder using a non equi-probable symbol distribution to recover ~~the~~ a partitioned symbol sequence, wherein the partitioned symbol sequence comprises a first part having K-bits, a second part having N*k-bits, and a third part having remaining bits.

46(Currently Amended).   The method according to claim 45 wherein the step of processing a plurality of signal points via the TTCM decoder comprises ~~the~~ a step of computing in each iteration, ~~the~~ a likelihood ratio for each data bit, which equals ~~the~~ a ratio between ~~the~~ a probability a bit is a '1' and the probability the bit is a '0'.

47(Currently Amended).   The method according to claim 46 wherein the step of computing in each iteration the likelihood ratio for each data bit comprises ~~the~~ a step of preparing a table of the probability distribution of associated data symbols.

48(Original).   The method according to claim 47 wherein the step of preparing a table of the probability distribution of associated data symbols comprises the step of simulating a transmitter and generating a symbol distribution histogram over a long period of time.